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Recent results of the TIMESPOT project on sensors and electronics developments for future vertex detectors

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The TIMESPOT project is a R&D project entirely funded by INFN –Italy. It is active since the end of 2017 and will operate for 3 years. The project aims at the construction of a mini-tracker demonstrator implementing both high space and time resolutions at the single pixel level. The pixels have a pitch of 55x55 μmˆ2. Specified r.m.s. time resolution is equal or better than 50 ps.
Sensors are based both on 3D silicon and diamond technologies, whose layout and fabrication process have been suitably optimized for best time resolution. Read-out pixel electronics is developed in 28-nm CMOS technology. The single pixel circuit contains one charge sensitive amplifier, one discriminator and one TDC per pixel.
The first batch of 3D silicon sensors, containing several test structures based on different geometries of the electrodes, has been delivered last June and is currently under characterization tests. Among the different structures being tested and compared, a high density trench-type layout has been realized, being particularly promising about timing performance.
I-V curves have been already extracted showing a general good behaviour of the sensors. Dynamic tests using a pulsed laser beam are on-going to evaluate the sensor performce in terms of charge collection efficiency and timing.
A first prototype of 3D column-type diamond sensor with optimized timing performance has been also realized and tested with encouraging results.
The first prototype of the 28-nm CMOS ASIC has been delivered in Spring 2019 and is being tested. One of the important results is the feasibility of integrating a high performance TDC (about 20 ps r.m.s. time resolution) inside a total pixel circuit area of 55x55 μmˆ2..
In the present paper our results on sensor and readout electronics tests will be illustrated. They represent an important step forward in the development of pixels with timing operating at extremely high interaction rates.

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